

**In the Drawings**

FIGs. 3, 5, 6, and 8 are amended as illustrated in the accompanying annotated drawing sheets. FIGs. 9 and 10 are newly added as the attachment.

Attachment A: Annotated drawing sheets.

Attachment B: Clean-copy of replacement and new drawing sheets.

### **REMARKS**

Claims 1, 10, 11, and 18 have been amended. Claims 9 and 17 are cancelled. Claims 2-5, 7-8, and 12-13, and 15-16 remain in this application. Claims 6, 14, have been withdrawn from consideration (subject to reconsideration upon allowance of a generic claim). Claims 19-32 have been canceled. Moreover, FIGs. 3, 5, 6, and 8 have been amended and FIGs. 9-10 have been added in the specification.

### **Drawings**

The drawings were objected to as not showing every feature of the claims (e.g. the metal trace structure being X-shaped, as claimed in claim 5, and the metal structure including a channel as claimed in claim 1).

The drawings were also objected to as being improperly cross-hatched.

As noted above, Figs. 3, 5, 6, and 8 have been amended herein, as noted in the accompanying annotated drawing sheets. Also, new Figs. 9 and 10 have been added to illustrate the X-shaped structure that was specifically described in the specification (and claimed). As the subject matter of these drawings was described in the originally-filed specification, the addition of Figs 9 and 10 adds no new matter to the application. Also, the replacement drawing sheets have provided better spacing of the figures (by providing two figures per sheet, rather than three).

### **Specification**

The Office Action also objected to the specification for various reasons. Applicant has made appropriate amendments to the specification, and as amended Applicant submits that the specification overcomes all objections.

Applicant notes, however, that the amendments made to the specification herein should not be construed as any substantive agreement with the objections. For example, the Office Action objected to the abstract as including "legal phraseology" because it included the term "comprising." The word comprising has a simple dictionary definition of "to include or contain." Applicant fails to see how such a common, simple word is deemed to be "legal phraseology." Notwithstanding, and in an effort to advance the prosecution of this application, Applicant has amended the abstract to replace the term "comprising" with its well-accepted synonym of "including."

#### **Rejections Under 35 U.S.C. 112 of Claims 1-5, 7-13 and 15-18**

The Office Action rejected claims 1-5, 7-13, and 15-18 under 35 U.S.C. § 112, second paragraph. Specifically, the rejection focused on the language of "the metal trace structure including a channel therein," embodied in claims 1 and 11, as being unclear. The specification and drawings have been amended to more clearly describe and illustrate this structure. Properly construing the claims in light of the specification (as amended), should render this rejection moot. Applicant, therefore, submits that claims 1 and 11 distinctly point out and distinctly claim the subject matter which applicant regards as the invention. Insofar as claims 2-5, 7-13 and 15-18 separately depend from amended claims 1 and 11, these claims are also overcome the rejection at least by virtue of their dependency. Accordingly, the Applicant requests that the rejections to claim 1-5, 7-13 and 15-18 be withdrawn.

#### **Rejections Under 35 U.S.C. 103(a) of Claims 1-5, 7-13 and 15-18**

Claims 1-2, 5, and 7-8 were rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Onodera et al (USPN 6,600,217, hereinafter "Onodera") in view of Iwasaki et al (USPN 6,777,814, hereinafter "Iwasaki"). In addition, claims 3-4, 9-10, and 17-18, and 11-13, 15-16 were rejected under 35 U.S.C.

103(a) as allegedly unpatentable over Onodera et al (USPN 6,600,217, hereinafter "Onodera") in view of Scholz et al (USPN 5,329,423, hereinafter "Scholz"), Lance et al (USPN 5,697,148, hereinafter "Lance"), and Iwasaki et al (USPN 6,777,814, hereinafter "Iwasaki"). Claim 1 and 11 are independent claims, from which claims 1-5, 7-13 and 15-18 depend. Applicant respectfully submits that claims 1 and 11 are patentable for at least the reasons discussed below, and therefore for at least the same reasons claims 1-5, 7-13 and 15-18 are patentable.

The Office Action asserts that "Onodera discloses a substrate structure, comprising a solder mask formed over a substrate. Iwasaki discloses a dummy metal area in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin to have a resultant enhanced reliability of the semiconductor device."

Independent claims 1 and 11, as amended, recite:

1. A substrate structure, comprising:

*a substrate with solder bumps on a main region and a peripheral region of a front side thereof;*  
*a solder mask formed over the front side of the substrate; and*  
*a metal trace structure formed within the solder mask;*  
*the metal trace structure including a channel therein for the receipt of underfill;*  
the metal trace structure further including a central portion with arms radiating outwardly therefrom, dividing the solder mask into separate areas.

11. A substrate structure, comprising:

*a substrate with solder bumps on a main region and a peripheral region of a front side thereof;*  
*a solder mask formed over the front side of the substrate; and*  
*a metal trace structure formed within the solder mask; the solder mask including a series of solder bumps not over the metal trace structure;*  
*the metal trace structure including a channel therein for the receipt of underfill;*  
the metal trace structure further including a central portion with arms radiating outwardly therefrom, dividing the solder mask into separate areas.

(Emphasis Added). Applicant submits that claims 1 and 11 (as amended) define over the cited art for at least the reason that the cited art fails to disclose the features emphasized above.

Independent claims 1 and 11 clearly and expressly recite a substrate with solder bumps on a main region and a peripheral region of a front side thereof.

However, as disclosed by Onodera in column 4, lines 1-3, and FIG 1: "The mounting substrate 1 is furnished with lands 2 to which electrodes of a semiconductor device are bonded." As is clearly described in Onodera, the lands 2 are disposed on the peripheral region of the mounting substrate 1. Furthermore, as disclosed by Iwasaki (see column 4 and FIG 2A), a plurality of the terminal electrodes 6 are formed near the edges on the circuit substrate 5. Thus, it is clear that neither Onodera nor Iwasaki teach a substrate with solder bumps on a main region and a peripheral region of a front side thereof, as claims 1 and 11. To properly reject the claims, the prior art must teach or at least suggest all claim limitations, which the cited references fail to do. Therefore, independent claims 1 and 11 are allowable over the cited references.

Insofar as claims 2-5, 7-10, 12-13, and 15-18 separately depend from claims 1 and 11, these claims are also allowable at least by virtue of their dependency.

In addition, amended claims 10 and 18 recite that the central portion of the metal trace structure includes a shaft disposed on a backside of the substrate and the channel is in communication with the shaft to receive the underfill. However, referring Onodera, a liquid or paste-form heat-curing adhesive 12 is applied at the approximate center of the mounting surface of the semiconductor device 10. The adhesive 12 first advances within the individual radial channels 4 and then flows in an expanding fashion from the radial channels 4 toward the periphery of the channels. Further, as cited in Iwasaki, nonconductive resin 7 is spread over a circuit substrate 5, which has terminal electrodes 6 thereon. An embodiment forms a dummy pattern 10 having good thermal conductivity on the surface of the circuit substrate 5 in order to make the temperature and viscosity distribution uniform even when using a chip of large size. Therefore, it is clear that neither Onodera nor Iwasaki teaches the central portion of the metal trace structure includes a shaft disposed on a backside of the substrate, and the underfill is received by the channel in communication with

the shaft, as recited in amended claims 10 and 18.

As a separate and independent basis for the patentability of independent claims 1 and 11, Applicants respectfully traverse the rejections as failing to identify a proper basis for combining the cited references. In combining these references, the Office Action stated only that the combination would have been obvious "in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device." (Office Action, page 7). This alleged motivation is clearly improper in view of well-established Federal Circuit precedent.

It is well-settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103, there must have been some teaching in the prior art to suggest to one skilled in the art that the claimed invention would have been obvious. W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc., 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

"The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. ..." Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure... In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention."

(*Emphasis added.*) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

In this regard, Applicant note that there must not only be a suggestion to combine the functional or operational aspects of the combined references, but that the Federal Circuit also requires the prior art to suggest both the combination of elements and the structure resulting from the combination. Stiftung v. Renishaw PLC, 945 Fed.2d 1173 (Fed. Cir. 1991). Therefore, in order

to sustain an obviousness rejection based upon a combination of any two or more prior art references, the prior art must properly suggest the desirability of combining the particular elements to derive an underfill method and structure, as claimed by the Applicant.

When an obviousness determination is based on multiple prior art references, there must be a showing of some “teaching, suggestion, or reason” to combine the references. Gambro Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the “absence of such a suggestion to combine is dispositive in an obviousness determination”).

Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved. See In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability, in whatever form, must nevertheless be “clear and particular.” Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617.

If there was no motivation or suggestion to combine selective teachings from multiple prior art references, one of ordinary skill in the art would not have viewed the present invention as obvious. See In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); Gambro Lundia AB, 110 F.3d at 1579, 42 USPQ2d at 1383 (“The absence of such a suggestion to combine is dispositive in an obviousness determination.”).

Significantly, where there is no apparent disadvantage present in a particular prior art reference, then generally there can be no motivation to combine the teaching of another reference

with the particular prior art reference. Winner Int'l Royalty Corp. v. Wang, No 98-1553 (Fed. Cir. January 27, 2000).

For at least the additional reason that the Office Action failed to identify proper motivations or suggestions for combining the various references to properly support the rejections under 35 U.S.C. § 103, those rejections should be withdrawn.


### CONCLUSION

In view of the foregoing, it is believed that all pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

No fee is believed to be due in connection with this amendment and response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,

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Annotated Sheet

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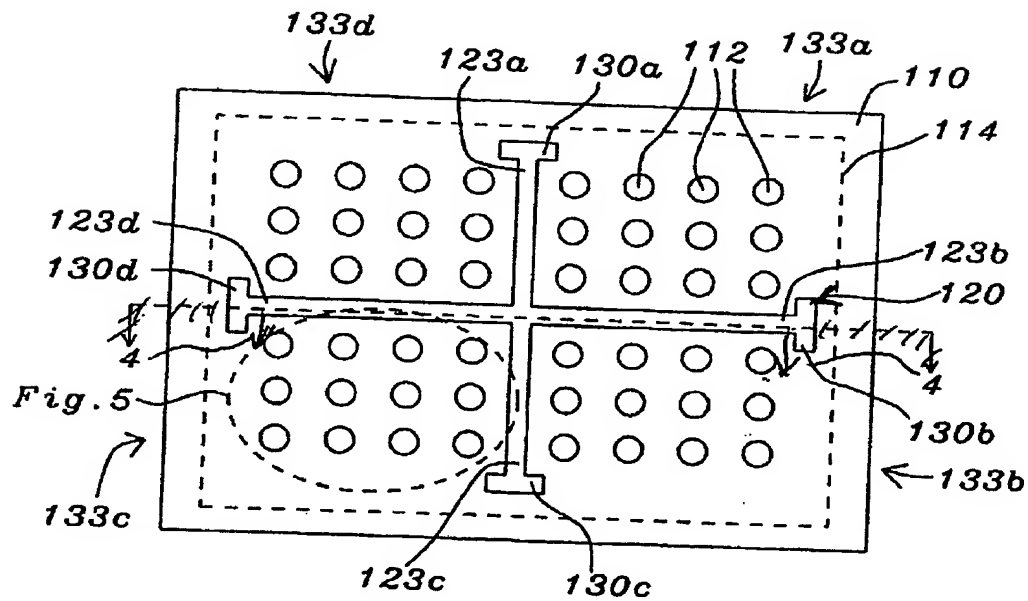


FIG. 3

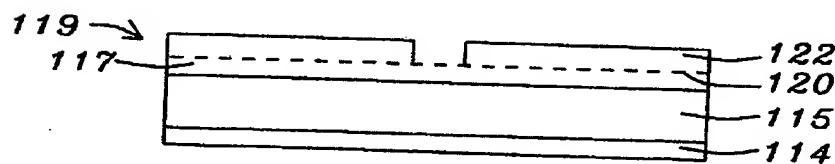


FIG. 4

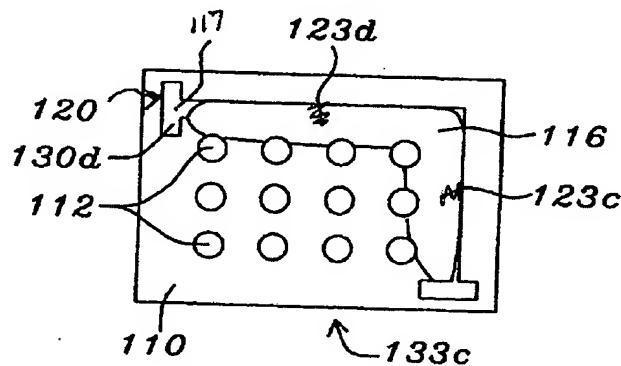


FIG. 5

Annotated Sheet

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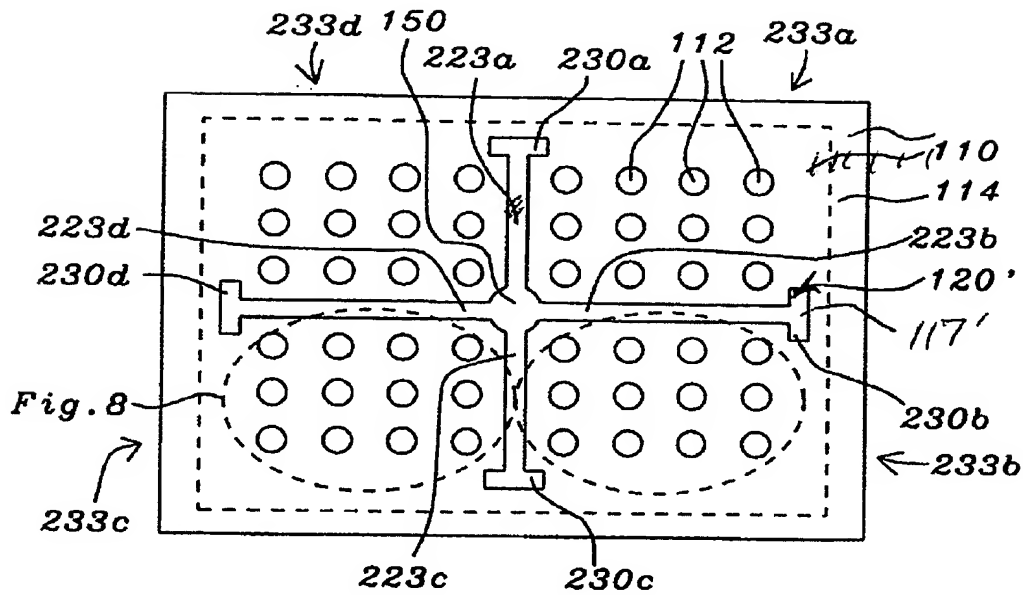


FIG. 6

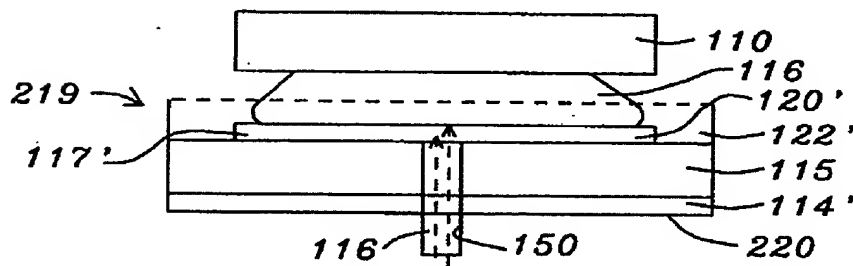


FIG. 7

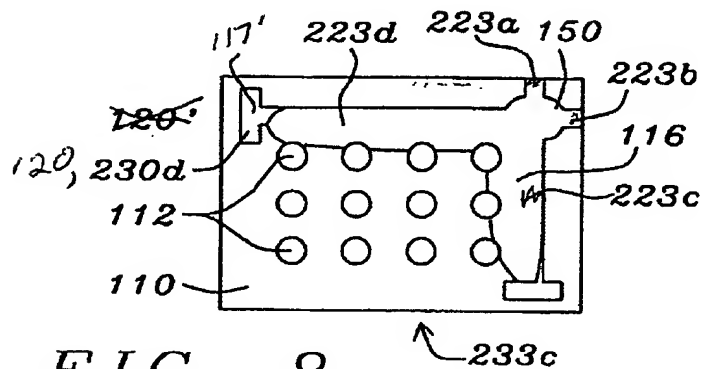


FIG. 8